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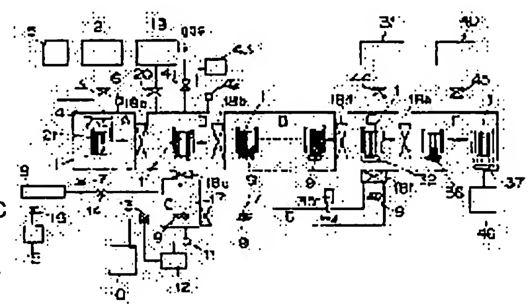
(54) APPARATUS AND METHOD FOR PRODUCTION OF LIQUID CRYSTAL DISPLAY ELEMENT

(57)Abstract:
PURPOSE: To provide means which can inline execute a series of stages from the deaeration of liquid crystal cells and the defoaming of liquid crystals to the sealing of the injection holes of the liquid crystal cells in an atm. pressure environment replaced with a vacuum or inert gas.
CONSTITUTION: A vacuum vessel A for the deaeration of the liquid crystal cells, a vacuum vessel C for the defoaming of the liquid crystals and a station D for immersion injection are respectively connected to a vacuum vessel B for injecting the liquid crystals to the liquid crystal cells. A vacuum vessel E for removing the excess liquid crystals and a vacuum vessel F for sealing are provided in the station D for immersion injection. A liquid crystal tray recovering station G for sending the liquid crystal trays to the vacuum vessel C by controlling the amt. of the liquid crystals in the liquid crystal trays is provided. The liquid crystal display element having excellent quality are obtd. in the large-sized liquid crystal cell substrates.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] In the manufacturing installation of the liquid crystal display component which pours in liquid crystal and forms a liquid crystal display component in a liquid crystal cell using the differential pressure and capillarity of liquid crystal cell inside and outside The liquid crystal impregnation vacuum housing which injects liquid crystal into a liquid crystal cell is prepared. To this liquid crystal impregnation vacuum housing The liquid crystal cell degassing vacuum housing which carries out the heat deairing of the liquid crystal cell, the liquid crystal degassing vacuum housing which carries out vacuum degassing of the liquid crystal, The immersion impregnation station left while the liquid crystal cell had been made immersed in liquid crystal is connected, respectively. In this immersion impregnation station While preparing the surplus liquid crystal removal container from which the liquid crystal cell and liquid crystal pan which received from the immersion impregnation station and were passed to the bottom of the atmospheric pressure which carried out inerting are separated, and surplus liquid crystal is removed, and the closure container which closes the liquid crystal inlet of a liquid crystal cell It has the liquid crystal pan recovery station which makes predetermined the amount of the liquid crystal of said separated liquid crystal pan, and is sent to said liquid crystal degassing vacuum housing. The manufacturing installation of the liquid crystal display component characterized by performing each process of the heat deairing of a liquid crystal cell, degassing of liquid crystal, impregnation of liquid crystal, removal of surplus liquid crystal, and the closure of an injected hole with in-line one to the bottom of the atmospheric pressure which carried out inerting the bottom of a vacuum environment.
[Claim 2] As vacuum treatment of a liquid crystal cell, a liquid crystal cell is arranged under the vacuum of 10-4Torr - 10-5Torr. While carrying out a heat deairing using non-contact type heating means, such as an infrared lamp, and making residue children, such as moisture, break away to the inside of a short time with a high vacuum mass exhaust air pump The manufacture approach of the liquid crystal display component characterized by terminating degassing down stream processing of a liquid crystal cell, and sending a liquid crystal cell to a vacuum impregnation process by detecting the emission gas constituents under degassing.
[Claim 3] As a degassing process of the liquid crystal with which the liquid crystal pan was filled up, the evacuation rate in the early stages of evacuation is enlarged. While carrying out degassing of the gas bubble which uses as a principal component air dissolved in liquid crystal promptly to the bottom of the vacuum of 10-2Torr - 10-3Torr The manufacture approach of the liquid crystal display component characterized by supervising the volatilizing liquid crystal component with a mass spectrometer, terminating degassing down stream processing of liquid crystal based on this monitor, and controlling the volatile matter of liquid crystal as much as possible.
[Claim 4] The manufacture approach of the liquid crystal display component characterize by it being smooth , and for a front face mixing liquid crystal and minute ****** which do not react in liquid crystal , promoting degassing of the gas bubble contain in liquid crystal , and performing degassing for a short time while adding the vibrational energy by the supersonic wave to the liquid crystal in a liquid crystal pan in the bottom of a vacuum environment as a degassing process of the liquid crystal with which the liquid crystal pan be filled up .
[Claim 5] In the process which carries out vacuum impregnation of the liquid crystal, the liquid crystal cell receipt fixture which supports to the liquid crystal cell receipt fixture which can hold the liquid crystal cell of one sheet or two or more sheets by fixed and uniform holding power in a liquid crystal cell, and supports a liquid crystal cell At least three press sections, The manufacture approach of the liquid crystal display component characterized by having a pressure sensor in the location corresponding to it, feeding back each pressure data value of a pressure sensor to the press section, and carrying out a cel cap to the homogeneity of the planar pressure force of a liquid crystal cell at regularity.
[Claim 6] In the process which carries out vacuum impregnation of the liquid crystal into a liquid crystal cell, where the pressure of a liquid crystal impregnation vacuum housing is held at 10-3Torr - 10-4Torr After the injected hole of this liquid crystal cell is immersed in the liquid crystal with which the liquid crystal pan which has arranged the liquid crystal cell and has been sent from the liquid crystal degassing vacuum housing in this liquid crystal impregnation vacuum housing was filled up, In case the pressure in a liquid crystal impregnation vacuum housing is ****(ed) more than atmospheric pressure or atmospheric pressure It acts as the monitor of the pressure variation to the **** condition from a vacua with an absolute-pressure vacuum gage. Liquid crystal is made to invade in a liquid crystal cell slowly with surface tension in a liquid crystal cell at first. The manufacture approach of the liquid crystal display component gradually characterized by ****** and enlarging the rate of **** gradually and carrying out program control of the **** rate to time amount according to the property of the substrate of a liquid crystal cell, the size of a liquid crystal cell, etc. while introducing gas, such as inert gas, little by little and lowering the

degree of vacuum in a liquid crystal impregnation vacuum housing.
[Claim 7] In the liquid crystal pan recovery station to which the liquid crystal pan collected from the immersion impregnation station is transported after injecting liquid crystal into a liquid crystal cell Management of the liquid crystal oil level of the liquid crystal pan made from the transparence member is performed using oil-level detection means, such as a transparency mold photoelectric switch. The manufacture approach of the liquid crystal display component characterized by sending the liquid crystal pan which supplied liquid crystal to proper level with the signal of said oil-level detection means, and held predetermined liquid crystal automatically with the restoration means to a liquid crystal degassing vacuum housing.
[Claim 8] The manufacture approach of the liquid crystal display component which wipes away surplus near [a liquid-crystal-cell injected hole] liquid crystal with a soft cleaning implement under the atmospheric pressure which carried out inerting, and is characterized by to close the injected hole of a liquid crystal cell with encapsulant under the atmospheric pressure which carried out inerting as a process which closes with encapsulant the injected hole of the liquid crystal cell connected to the process which carries out surplus liquid-crystal removal as a process in which the liquid crystal cell which completed liquid-crystal impregnation carries out surplus liquid-crystal removal.
[Claim 9] The manufacture approach of the liquid crystal display component according to claim 8 characterized by irradiating ultraviolet rays and stiffening encapsulant after applying the encapsulant of ultraviolet curing mold resin to the injected hole part of a liquid crystal cell under the atmospheric pressure which carried out inerting as a process which closes the injected hole of a liquid crystal cell with encapsulant.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the manufacturing installation at the time of injecting liquid crystal into a liquid crystal display component, and its approach.
[0002]
[Description of the Prior Art] It faced manufacturing, and the process of a liquid crystal display component which injects liquid crystal into a liquid crystal cell is an important process, and has had direct effect on display quality or the yield. As an approach of injecting liquid crystal into a liquid crystal cell, the vacuum impregnation approach is the most common.
[0003] After the conventional vacuum impregnation approach installs a liquid crystal cell and liquid crystal in a vacuum housing and holds the pressure in a vacuum housing to the degree of vacuum of 10-3Torr extent, it pours in liquid crystal by the capillarity in the minute gap in the differential pressure force of liquid crystal cell inside and outside, and a liquid crystal cell (gap) by making the injected hole of a liquid crystal cell immersed in liquid crystal, and ****(ing) the inside of a vacuum housing to atmospheric pressure.
[0004] By such conventional method, there was a trouble that the time amount which the residual of air bubbles produces inside a liquid crystal cell, or impregnation takes on the occasion of the liquid crystal impregnation to a liquid crystal cell by using for example, flexible film substrates other than a glass substrate as a liquid crystal cell substrate again could not turn into long duration by enlargement of a liquid crystal cell, or display quality could not secure regularly according to the impregnation condition of liquid crystal.
[0005] It is required to fully make the inside of a liquid crystal cell into negative pressure (vacua), and to remove the moisture and impurity inside a liquid crystal cell in order to control a residual and generating (air bubbles of operation by electric-field impression) of the air bubbles after impregnation, and it is performing this in advance before impregnation of liquid crystal. It does not carry out in a vacuum impregnation container, but is carrying out with another container by clean oven or vacuum degassing as separate vacuum treatment at the former. By such conventional approach, degassing and the liquid crystal cell which carried out degasifying will fully be again put into atmospheric air, and it has the fault which becomes disadvantageous for the effectiveness of the following vacuum impregnation process, or quality reservation by **** inside reattachment, such as moisture, or a cel.
[0006] In order to pour in without similarly making the injected hole of a liquid crystal cell immersed in liquid crystal, and being accompanied by residual air bubbles, it is left as it is in air, but when especially a liquid crystal cell is a flexible film substrate, adhesion and transparency of moisture or an air component pose a problem. Although an injected hole is closed with encapsulant when impregnation is furthermore completed, it is invasion of the impurity of an air component or others, and the cause of the cellular residual in a liquid crystal cell to perform wiping of the surplus liquid crystal near an injected hole, and encapsulant spreading and hardening of ultraviolet curing mold resin in air.
[0007] Moreover, in the vacuum treatment before liquid crystal impregnation of a liquid crystal cell, the moisture of the evacuation conventionally performed by 10-3Torr - 10-4Torr etc. was inadequate for degassing of an impurity, and when using a lot of large-sized cel substrates and film substrates, it was difficult [it] to shorten degassing time amount sharply. Furthermore, from there being no means to get to know the degassing condition (the degassing effectiveness) of a cel, in spite of having fully completed degassing, it has the fault of continuing vacuum treatment uselessly.
[0008] Although conventionally carried out in the degree of vacuum of 10-2Torr - 10-4Torr extent, if long duration evacuation is continued in the condition that the gas dissolved in liquid crystal finished ****ing, the component of liquid crystal volatilizes, the inside of a vacuum housing is polluted or degassing (degassing) of the gas which exists in liquid crystal has become a cause [exhausting / liquid crystal / excessive]. Therefore, the evacuation for degassing needs to stop volatile matter so that may carry out evacuation (slow exhaust air) slowly, exhaust velocity may be enlarged gradually, degassing may be promptly performed so that the bubble generated from liquid crystal beginning to lengthen may explode and liquid crystal may not disperse, and a liquid crystal component may not carry out presentation change further.
[0009] Moreover, although the magnet stirrer was used at the conventional degassing process of liquid crystal, carrying out evacuation in order to promote the desorption of a dissolved gas, this had the inclination to diffuse small air bubbles rather and for degassing time amount to become long.
[0010] If a liquid crystal cell is placed into a vacuum housing when pouring in liquid crystal into the liquid crystal cell

made with the large-sized liquid crystal cell substrate, especially the flexible film substrate, the nonuniformity of the liquid crystal into which the liquid crystal cell expanded and contracted and was poured according to the difference of the external pressure in a liquid crystal cell will have occurred. Since the nonuniformity of impregnation influences display quality, it needs to hold a cel at fixed spacing, and it needs to pour it in so that the gap in a liquid crystal cell may not change a lot.

[0011] In case liquid crystal is injected into a liquid crystal cell, liquid crystal enters the interior of the liquid crystal cell which was placed into the vacuum housing and it fully changed into the reduced pressure (vacuum) condition with a liquid crystal cell gap and the surface tension of liquid crystal at the beginning of impregnation. When **** (the inside of a vacuum housing is leaked) was rapidly performed at this time, the gap agent currently sprinkled in order to keep the gap in a liquid crystal cell constant moved, and there was a problem of how not becoming homogeneity. [liquid crystal] Especially, in the cel of a flexible film substrate or a large-sized substrate, management of time amount until it completes the rate in the case of ****(ing) (leak rate) and impregnation was difficult, and there was a trouble of air bubbles tending to remain.

[0012] Moreover, although surplus liquid crystal was wiped off and the injected hole was closed using encapsulant after pouring in liquid crystal into a liquid crystal cell conventionally, each of these processes was performed in air, and neither a foreign matter nor air was able to invade at the time of encapsulant spreading, they was not able to cause [air was not able to enter from an injected hole in this case at the time of wiping of surplus liquid crystal, or] the poor closure in many cases, and the stable quality was not able to be secured. Furthermore, ultraviolet curing mold resin is influenced to moisture or the oxygen in air, especially causes long term deterioration of quality about moisture.

[0013]

[Problem(s) to be Solved by the Invention] This invention aims at offering the outstanding way in each process for injecting liquid crystal into a liquid crystal cell for the purpose of offering the approach and equipment which can perform a series of processes from the process of degassing of a liquid crystal cell, and degassing of liquid crystal to the process of the closure of the injected hole of a liquid crystal cell with in-line one to the bottom of a vacuum environment (a part is inerting) in order to improve an above-mentioned fault point.

[0014] And under a vacuous environment, after this invention performs degassing of a liquid crystal cell, degassing of liquid crystal, and impregnation of liquid crystal, it can be processed under the environment where neither air nor moisture is touched also in each process of removal of surplus liquid crystal, and the closure of an injected hole, and aims at offering a means by which the liquid crystal display component of high quality can be manufactured.

[0015] While mass-producing a liquid crystal display component at each process of this invention, by it, the vacuum treatment of an efficient liquid crystal cell is offered at the minimum cost. The degassing process which can be certainly performed quickly by adding vibrational energy without preventing presentation change of liquid crystal and diffusing the air bubbles in liquid crystal is offered. Moreover, the liquid crystal impregnation process that the gap between the substrates of a liquid crystal cell is uniformly maintainable is offered in the case of liquid crystal impregnation. Furthermore, it aims at offering each process of the surplus liquid crystal removal which can be performed under the environment which offered the liquid crystal pan impregnation station which maintains uniformly the oil level of the liquid crystal pan used in case liquid crystal is injected into a liquid crystal cell, and eliminated moisture and oxygen, and the closure.

[0016]

[Means for Solving the Problem] In the manufacturing installation of the liquid crystal display component which pours in liquid crystal and forms a liquid crystal display component in a liquid crystal cell using the differential pressure and capillarity of liquid crystal cell inside and outside in order that this invention may attain said purpose The liquid crystal impregnation vacuum housing which injects liquid crystal into a liquid crystal cell is prepared. To this liquid crystal impregnation vacuum housing The liquid crystal cell degassing vacuum housing which carries out the heat deairing of the liquid crystal cell, the liquid crystal degassing vacuum housing which carries out vacuum degassing of the liquid crystal, The immersion impregnation station left while the liquid crystal cell had been made immersed in liquid crystal is connected, respectively. In this immersion impregnation station While preparing the surplus liquid crystal removal container from which the liquid crystal cell and liquid crystal pan which received from the immersion impregnation station and were passed to the bottom of the atmospheric pressure by which inerting was carried out are separated, and surplus liquid crystal is removed, and the closure container which closes the liquid crystal inlet of a liquid crystal cell It has the liquid crystal pan recovery station which makes predetermined the amount of the liquid crystal of said separated liquid crystal pan, and is sent to said liquid crystal degassing vacuum housing. It is characterized by performing each process of the heat deairing of a liquid crystal cell, degassing of liquid crystal, impregnation of liquid crystal, removal of surplus liquid crystal, and the closure of an injected hole with in-line one to the bottom of the atmospheric pressure which carried out inerting the bottom of a vacuum environment.

[0017] Moreover, this invention arranges a liquid crystal cell under the vacuum of 10-4Torr - 10-5Torr as vacuum treatment of liquid crystal. While carrying out a heat deairing using non-contact type heating means, such as an infrared lamp, and making residue children, such as moisture, break away to the inside of a short time with a high vacuum mass exhaust air pump By detecting the emission gas constituents under degassing, degassing down stream processing of a liquid crystal cell is terminated, and it is characterized by sending a liquid crystal cell to a vacuum impregnation process.

[0018] This invention enlarges the evacuation rate in the early stages of evacuation as a degassing process of the

liquid crystal with which the liquid crystal pan was filled up. While carrying out degassing of the gas bubble which uses as a principal component air dissolved in liquid crystal promptly to the bottom of the vacuum of 10-2Torr - 10-3Torr Supervise the volatilizing liquid crystal component with a mass spectrometer, and degassing down stream processing of liquid crystal is terminated based on this monitor. While being characterized by controlling the volatile matter of liquid crystal as much as possible and adding the vibrational energy by the supersonic wave to the liquid crystal in a liquid crystal pan in the bottom of a vacuum environment It is smooth, and a front face mixes liquid crystal and minute ****** which does not react in liquid crystal, promotes degassing of the gas bubble contained in liquid crystal, and is characterized by performing degassing for a short time.
[0019] This invention is supported in the process which carries out vacuum impregnation of the liquid crystal into a liquid crystal cell to the liquid crystal cell receipt fixture which can hold the liquid crystal cell of one sheet or two or more sheets by fixed and uniform holding power. The liquid crystal cell receipt fixture which supports a liquid crystal cell has a pressure sensor in at least three press sections and the location corresponding to it, feeds back each pressure data value of a pressure sensor to the press section, and is characterized by carrying out a cel cap to the homogeneity of the planar pressure force of a liquid crystal cell at regularity.
[0020] This invention is in the condition which held the pressure of a liquid crystal impregnation vacuum housing in the process which carries out vacuum impregnation of the liquid crystal at 10-3Torr - 10-4Torr in the liquid crystal cell. After the injected hole of this liquid crystal cell is immersed in the liquid crystal with which the liquid crystal pan which has arranged the liquid crystal cell and has been sent from the liquid crystal degassing vacuum housing in this liquid crystal impregnation vacuum housing was filled up, In case the pressure in a liquid crystal impregnation vacuum housing is ****(ed) more than atmospheric pressure or atmospheric pressure It acts as the monitor of the pressure variation to the **** condition from a vacua with an absolute-pressure vacuum gage. Liquid crystal is made to invade in a liquid crystal cell slowly with surface tension in a liquid crystal cell at first. It is gradually characterized by ****** and enlarging the rate of **** gradually and carrying out program control of the **** rate to time amount according to the property of the substrate of a liquid crystal cell, the size of a liquid crystal cell, etc., introducing gas, such as inert gas, little by little, and lowering the degree of vacuum in a liquid crystal impregnation vacuum housing.
[0021] Furthermore, after this invention injects liquid crystal into a liquid crystal cell, it is set to the liquid crystal pan recovery station to which the liquid crystal pan collected from the immersion impregnation station is transported. Management of the liquid crystal oil level of the liquid crystal pan made from the transparence member is performed using oil-level detection means, such as a transparency mold photoelectric switch. Liquid crystal is supplied to proper level with the signal of said oil-level detection means, and it is characterized by sending the liquid crystal pan which held predetermined liquid crystal automatically with the restoration means to a liquid crystal degassing vacuum housing.
[0022] As a process in which the liquid crystal cell which completed liquid crystal impregnation carries out surplus liquid crystal removal, this invention wipes away surplus near [a liquid crystal cell injected hole] liquid crystal with a soft cleaning implement under the atmospheric pressure by which inerting was carried out, and is characterized by to close the injected hole of a liquid crystal cell with encapsulant under the atmospheric pressure by which inerting was carried out as a process which closes with encapsulant the injected hole of the liquid crystal cell connected to the process which carries out surplus liquid crystal removal.
[0023]
[Function] The liquid crystal display component which touched neither air nor moisture in the removal process of surplus liquid crystal or the closure process of an injected hole by performing each process from degassing of a liquid crystal cell and degassing of liquid crystal to the closure of the injected hole of a liquid crystal cell with in-line one to the bottom of a vacuum or the environment of inerting, and was excellent in quality in the large-sized liquid crystal cell substrate or the flexible film substrate with the configuration of this invention can be obtained.
[0024]
[Example] Hereafter, the example of this invention is explained based on a drawing. The outline of the whole equipment of this invention is shown in drawing 1 . They are the liquid crystal impregnation process of this invention, i.e., degassing of a liquid crystal cell, degasifying, degassing of liquid crystal, and the block diagram of the equipment which performs each process, such as the closure of impregnation of liquid crystal and the injected hole of a liquid crystal cell, with in-line one to a liquid crystal cell.
[0025] In the vacuum housing B (henceforth a liquid crystal impregnation vacuum housing) which injects liquid crystal into a liquid crystal cell While the vacuum housing C (henceforth a liquid crystal degassing vacuum housing) which performs degassing of a liquid crystal cell and degassing of liquid crystal which put the liquid crystal of the specified quantity into true container sky A (henceforth a liquid crystal cell degassing vacuum housing) which performs degasifying, and a liquid crystal pan is connected The immersion impregnation station D which pours in liquid crystal completely into a liquid crystal cell is connected. In the immersion impregnation station D In Container E (henceforth a surplus liquid crystal removal container) and this surplus liquid crystal removal container E which remove the liquid crystal which separated the liquid crystal cell from the liquid crystal pan, and adhered to the liquid crystal cell The liquid crystal pan recovery station G into which a liquid crystal pan is sent is connected with the container F (henceforth a closure container) which closes the injected hole of a liquid crystal cell. And the other end of the liquid crystal pan recovery station G is connected to said liquid crystal degassing vacuum housing C.
[0026] First, configuration and actuation of the liquid crystal cell degassing vacuum housing A are explained. The liquid crystal cell 1 arranged in the liquid crystal cell degassing vacuum housing A makes a degree of vacuum

(pressure) 10-5Torr extent by the high vacuum mass vacuum exclusion system 2 which uses cryopump (or turbo molecular pump) as a main process pump, and performs degassing of a liquid crystal cell 1, and degasifying. A degree of vacuum is 10-4Torr extent, even when there are many burst sizes of moisture. 3 is a vacuum bulb.

[0027] And the material of a liquid crystal cell heats to homogeneity in physics and the temperature requirement which does not deteriorate chemically with the infrared-heating lamp 4 arranged in the liquid crystal cell degassing vacuum housing A under such a vacuum, and while removing impurities, such as moisture of liquid crystal cell 1 inside and outside, the interior of a liquid crystal cell is made into a vacuum. 5 is a power source which operates said infrared-heating lamp 4. The liquid crystal cell 1 is set to the impregnation fixture mentioned later. In the case of plastics, said temperature is sufficient as whenever [stoving temperature / of a liquid crystal cell], but in the case of glass, you may heat to temperature higher than plastics, for example, near 100 degree C.

[0028] By disconnection of a bulb 7, the degree of vacuum of this liquid crystal cell degassing vacuum housing A connects a mass spectrometer 8 with the liquid crystal cell degassing vacuum housing A, and performs gas analysis in the liquid crystal cell degassing vacuum housing A with a mass spectrometer 8 while it is measured by the ionization vacuum gage 6. The degree of vacuum according to an ionization vacuum gage 6 in drawing 11 , and H2 O+ by the mass spectrometer 8 It acts as the monitor of the ion current value of a mass spectrum, and it is the graph which followed that time amount change, and with this graph, it detects having become below the level that both the degree of vacuum and the H2 O partial pressure value set as the inside of fixed time amount beforehand, and processing by the liquid crystal cell degassing vacuum housing A is ended. By drawing 1 , it has omitted about the rough ** (vacuum) exhaust air system and leak valve attached to the liquid crystal cell degassing vacuum housing A.

[0029] Next, the configuration and actuation of the liquid crystal degassing vacuum housing C are explained. In parallel to the processing in the liquid crystal cell degassing vacuum housing A, it is collected from the liquid crystal pan recovery station G, and ******** 9 which maintains a liquid crystal oil level at a correct level is sent to the liquid crystal degassing vacuum housing C. Evacuation of the liquid crystal degassing vacuum housing C is carried out in the range of 10-1 - 10-4Torr by the mechanical-booster-pump exhaust air system 10.

[0030] At this time, gas analysis in the liquid crystal degassing vacuum housing C is performed by the mass spectrometer 8, and it is O2 of an air component. And the fragmentation of H2 O of moisture and a liquid crystal component is detected, and it acts as the monitor of that time amount change. Like the graph shown in drawing 12 as an example, it is O2. By a partial pressure and an H2 O partial pressure becoming below the level of a fixed setup, and detecting that the fragment ion of a liquid crystal component began to increase greatly, a degree of vacuum is controlled and it prevents that a liquid crystal component volatilizes. Control of a degree of vacuum is performed by controlling the adjustable conductance bulb 13 by the pressure controller 12 using a diaphragm gage 11.

[0031] Since it is the field which cannot use a mass spectrometer 8 directly in the state of a degree of vacuum in gas analysis in the liquid crystal degassing vacuum housing C, it analyzes by performing differential pumping using the turbo molecular pump exhaust air system 15, opening a bulb 14 and introducing gas. The bulb 16 is closed when not using a differential-pumping method. In addition, when performing [be / it / under / processing / of the liquid crystal cell degassing vacuum housing A and the liquid crystal degassing vacuum housing C / concurrency] gas analysis, it is made to analyze by switching a bulb 7 and a bulb 16.

[0032] As mentioned above, in case the process of evacuation is controlled by performing the liquid crystal degassing process of this invention in a vacuum using a conductance adjustable bulb, the gas dissolved in liquid crystal can be removed without being accompanied by scattering of liquid crystal, and volatilization of liquid crystal, and a degassing process can be performed quickly. Moreover, by detecting the fragment ion of the volatile component of liquid crystal by the gas analysis by the mass spectrometer, it can control in the process of evacuation that liquid crystal does not volatilize, and stabilization of protection quality is beforehand achieved in component change of liquid crystal.

[0033] Drawing 6 explains degassing of the liquid crystal 17 in the liquid crystal degassing vacuum housing C, and the outline of degassing processing. Minute ****** 29 is mixed in the liquid crystal 17 held in the liquid crystal pan 9. And an ultrasonic generator 30 is arranged under the liquid crystal pan 9, and a supersonic wave is added to the liquid crystal 17 which mixed minute ****** 29. At this time, it is also possible to perform degassing, establishing and heating a heating device in a vacuum housing C, and, especially in the case of strong dielectric liquid crystal, it is convenient. As said minute ****** 29, a front face is very smooth, and it is liquid crystal and ****** with a diameter of 0.2-0.8mm which does not react, and, as for the specific gravity, it is [aluminum, Teflon, etc. can be used and] desirable that it is a little heavier than liquid crystal. Therefore, the gas dissolved in liquid crystal is [that there are no residual air bubbles quickly] removable with the moderate temperature rise caused in the time of liquid crystal degassing by the vibrational energy and it by the supersonic wave.

[0034] Subsequently, the configuration and actuation of the liquid crystal impregnation vacuum housing B are explained. The liquid crystal pan 9 which held the liquid crystal 17 processed by the liquid crystal cell 1 (what set to the impregnation fixture) and the liquid crystal degassing vacuum housing C which were processed by the liquid crystal cell degassing vacuum housing A is sent into the liquid crystal impregnation vacuum housing B by which evacuation was beforehand carried out to 10-3 - 10-4Torr through gate valves 18a and 18c, respectively, and is installed in the condition of drawing 1 . Evacuation of the liquid crystal impregnation vacuum housing B is carried out by the turbo molecular pump exhaust air system 19. The rough ****** system and leak system of a vacuum housing B are omitted by drawing 1 . 20 is a vacuum bulb.

[0035] A liquid crystal cell 1 is supported by the impregnation fixtures 21a-21c as shown in drawing 2 (a). In drawing 2 , a liquid crystal cell 1 keeps between liquid crystal cells constant, it is supported through the buffer sheet 22 for making the planar pressure force at the time of press into homogeneity, and the impregnation fixtures 21a-21c are arranged at the both sides. And as a liquid crystal cell 1 is shown in drawing 2 (b), the location of the liquid crystal pan 9 is adjusted so that the injected hole part may be immersed in the interior of the liquid crystal 17 in the liquid crystal pan 9.
[0036] The liquid crystal cell 1 is carrying out the cross-section configuration from a transverse plane as shown in drawing 3 , and, as for the seal section and 1c, the area and 1b into which, as for 1a, liquid crystal is poured show the injected hole. In one side of the impregnation fixtures 21a-21c located in the both ends of the liquid crystal cell 1 which consisted of flexible film substrates, to be shown in drawing 4 , at least three pressure sensors 23 are arranged, and while holding so that it may become fixed about the total pressure in the 1st page of a liquid crystal cell with this pressure sensor 23, it controls to make the pressure distribution at the time of the press within a field into homogeneity. 24 is some fixtures for a press prepared in the field of another side of the impregnation fixtures 21a-21c. In the case of a flexible film substrate, the press of a liquid crystal cell is effective, but also in the case of a glass substrate, it is effective.
[0037] An example of the press approach of a liquid crystal cell 1 is shown in drawing 5 . In this drawing 5 , it has the structure where a press pressure can be adjusted to the bottom of a vacuum, and in 25, coupling and 27 are the screw sections and the rotation introducer for vacuums and 26 change rotation of the rotation introducer for vacuums into the rectilinear motion for press. Therefore, if the signal from the pressure sensor 23 of the impregnation fixture 21 is given to the rotation introducer 25 for vacuums arranged on the outside of the wall 28 of a vacuum housing, the predetermined screw section 27 will move forward and backward, and the fixture 24 for a press will act so that a pressure may become fixed over the whole surface of a liquid crystal cell.
[0038] By enlargement of the cell size according to a large-sized cel substrate or a flexible film substrate especially, the fault which generating of the shade section of liquid crystal and the ununiformity of a cel gap tend to produce at the time of impregnation can attain stabilization of the display quality of a liquid crystal display component by securing the homogeneity of the fixed planar pressure force with the press means at the time of impregnation processing, as mention above. Since the homogeneity of the force [in the field of a liquid crystal cell] to press can be secured changing the interior of a cel into a reduced pressure condition under a vacuum before impregnation in this invention, it is possible to set up exact impregnation conditions (press impregnation).
[0039] In the liquid crystal impregnation vacuum housing B, after making injected hole 1c of a liquid crystal cell 1 immersed in liquid crystal 17 as shown in drawing 2 (b), as shown in drawing 13 , it **** sequentially from a vacua to atmospheric pressure (or pressure of extent pressurized a little from atmospheric pressure). The pressure of the liquid crystal impregnation vacuum housing B by which evacuation was carried out to 10-4Torr as shown in drawing 13 is time amount t1 first. In between, gas is introduced slowly and they are ****** and time amount t2. The leak rate of gas is enlarged in between and it is time amount t3. It leaks gradually again in between and is time amount t4 further. It **** to atmospheric pressure comparatively quickly in between. And the need is accepted and it is time amount t5. A pressure is further heightened from atmospheric pressure in between. This sequence is a fundamental pattern and can be changed with the class of liquid crystal, and the magnitude of a liquid crystal cell substrate. In drawing 1 , 41 is the amount leak bulb of variable flow, and this amount leak bulb 41 of variable flow can control a pressure controller 43 by the vacuum gage 42, and can introduce gas as mentioned above.
[0040] Therefore, in this invention, without causing migration of a gap agent by controlling a **** condition according to the size of a liquid crystal cell, liquid crystal can be poured into homogeneity into a liquid crystal cell at all parts, and the residual air bubbles at the time of impregnation can be lost. And fertilization of a liquid crystal display component can be attained by making it change with the sequential programs of a pressure (a degree of vacuum is also included) and time amount from a vacuum according to the size of a liquid crystal cell besides carrying out time management of the process which **** to a pressure higher than atmospheric pressure or atmospheric pressure.
[0041] In the liquid crystal impregnation vacuum housing B, after injecting liquid crystal 17 into a liquid crystal cell 1 by the vacuum pouring-in method, in order to pour in liquid crystal 17 completely into a liquid crystal cell 1 and not to leave residual air bubbles, the liquid crystal cell 1 in the condition of having been immersed in liquid crystal 17 is sent to the immersion impregnation station D through gate valve 18b which divides a vacuum and an atmospheric pressure. At the immersion impregnation station D, it continues in at least 3 hours under the clean environment of a nitrogen gas flow or nitrogen inert gas replacement, and while injected hole 1c of a liquid crystal cell 1 had been made immersed in liquid crystal 17, it is sent.
[0042] At the immersion impregnation station D, after finishing injecting liquid crystal into a liquid crystal cell 1 completely, a liquid crystal cell 1 and the liquid crystal pan 9 are sent to the surplus liquid crystal removal container E through gate valve 18d. And with this surplus liquid crystal removal container E, slowly, after exhaust air, the liquid crystal pan 9 is separated from a liquid crystal cell 1 under the environment which carried out inerting, and by the rotary-pump exhaust air system 31, as shown in drawing 7 , surplus liquid crystal 17a adhering to a liquid crystal cell 1 can rotate the roller 32 of the sponge quality of the material, and can wipe it off softly. 44 is a vacuum bulb. The liquid crystal cell 1 which had surplus liquid crystal 17a wiped off is sent to the closure container F through gate valve 18e. Then, the liquid crystal pan 9 is sent to the liquid crystal pan recovery station G through gate valve 18f.
[0043] At the liquid crystal pan recovery station G, as shown in drawing 8 , by the transparency mold photoelectric switches 33a and 33b arranged at the both sides of the liquid crystal pan 9 which can be penetrated, and 34a and

34b When inferior-surface-of-tongue level is set up on the oil level in the liquid crystal 17 of the liquid crystal pan 9 and the location of a liquid crystal oil level is downward from the inferior-surface-of-tongue level of a setup, liquid crystal 17 is supplied using the supplement means 35, such as a dispenser, and is filled up in the range in which the oil level does not exceed the top-face level of a setup.

[0044] At the liquid crystal pan recovery station of this invention, by a non-contact means' detecting automatically the amount of the liquid crystal in a liquid crystal pan, and supplying liquid crystal automatically, in impregnation, required oil-level management can be performed by uninhabited, and it can contribute to the automation which is the impregnation process of liquid crystal greatly. And the gas is dissolved, and there is no need of performing management and supply of a liquid crystal oil level within a vacuum housing, and it will carry out under clarification environments, such as a clean tunnel, and will usually send to the liquid crystal supplied from such a liquid crystal pan recovery station at the vacuum housing for liquid crystal degassing.

[0045] After making encapsulant 36 immersed as the injected hole 1c part of a liquid crystal cell 1 is shown in the closure container F at drawing 9 , the encapsulant 36 which adhered to said injected hole 1c part as shown in drawing 10 is hardened by the exposure light 38 of UV light source lamp 37 in inerting atmospheric pressure, and the closure of the injected hole 1c is carried out. 39 is a shield for making it UV irradiation light not be equivalent to parts other than encapsulant, and prevents deterioration of liquid crystal and a substrate. In addition, although evacuation of the closure container F is carried out by the rotary-pump exhaust air system 40, the leak system is not illustrating. 45 is a vacuum bulb and 46 is the power source of UV light source lamp.

[0046] As mentioned above, in order to wipe off surplus liquid crystal 17a which adhered near liquid crystal cell injected hole 1c in this invention, After exhausting with a vacuum pump slowly, introduce inert gas (N2 gas etc.) from the gas feed system which is not illustrated, and it considers as atmospheric pressure. Make the sponge roller 32 contact near an injected hole end face, suck up surplus liquid crystal 17a adhering to an injected hole end face, and it sets under the atmospheric pressure environment of the same inert gas after that. By being immersed into encapsulant or applying injected hole 1c using spreading means, such as a dispenser, where invasion of the air into a liquid crystal cell is prevented, the perfect closure can be performed. Mixing of the moisture and impurity constituting the big cause of a property change with time as a display device other than invasion of the air into a liquid crystal cell can also be prevented under a vacuum.

[0047]

[Effect of the Invention] In order to connect a vacuum housing and to process each process, such as degassing of a liquid crystal cell, degasifying, degassing of liquid crystal, vacuum impregnation, liquid crystal immersion, encapsulant spreading, and hardening of encapsulant, with in-line one under a vacuum or the environment of inerting by the configuration of this invention, It can move continuously and each process of the liquid crystal cell from degassing of a liquid crystal cell to the closure of an injected hole can be processed. It has the effectiveness of obtaining the liquid crystal display component which does not have the fault of mixing into the heterogeneity of the color tone by the shade section of residual air bubbles or liquid crystal , and the cel of moisture or an impurity , the defect of the closure section , etc. to a large-sized cel substrate or a flexible film substrate and by which quality was stabilized , without touching air and moisture in all processes .

[0048] Moreover, by heating a liquid crystal cell to homogeneity with a non-contact type heating means, and performing degassing and degasifying into a high vacuum, by the configuration of this invention The interior of a cel can be changed into few reduced pressure (vacuum) conditions of impurities, such as moisture, and liquid crystal can be poured in. The display device of the stable quality is securable, and gas analysis of degassing and the degasifying condition can be carried out with a mass spectrometer, the termination can be known, and it has the effectiveness that efficient degassing and degasifying processing can be performed and improvement in productivity can be aimed at.

[0049] In this invention, by performing degassing of liquid crystal in a vacuum, furthermore, scattering of liquid crystal, While being able to remove the gas dissolved in liquid crystal, being able to perform degassing quickly, preventing component change of liquid crystal and achieving stabilization of the quality of a liquid crystal display component, without being accompanied by volatilization of liquid crystal It has the effectiveness that the gas dissolved in liquid crystal by the moderate temperature rise caused in the time of liquid crystal degassing by the vibrational energy and it by the supersonic wave is [that there are no residual air bubbles quickly] removable.

[0050] The homogeneity of the fixed planar pressure force is securable in this invention also to a large-sized cel substrate as a liquid crystal impregnation process with a press means at the time of impregnation processing. Without causing migration of a gap agent by being able to perform stabilization of display quality and controlling a **** condition according to the size of a liquid crystal cell, liquid crystal can be poured into homogeneity at all parts, and it has the effectiveness that the residual air bubbles at the time of impregnation can be lost.

[0051] At the liquid crystal pan recovery station of this invention, by a non-contact means' detecting reduction in liquid crystal automatically, and supplying liquid crystal automatically, in impregnation, required oil-level management can be performed by uninhabited, and it has the effectiveness which can contribute to the automation which is an impregnation process greatly. And it has the effectiveness which can prevent invasion of the air into a liquid crystal cell, and can prevent mixing of the moisture and impurity which affect the property change with time as a display device by performing a surplus liquid crystal removal process and a closure process to the bottom of the atmospheric pressure permuted with inert gas.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the outline of the whole manufacturing installation of the liquid crystal display component of this invention.
[Drawing 2] (a) shows the relation of a liquid crystal cell and an impregnation fixture, and (b) is the outline sectional view showing the relation of a liquid crystal cell and a liquid crystal pan.
[Drawing 3] It is the outline sectional view of a liquid crystal cell.
[Drawing 4] It is the outline sectional view showing the relation of the pressure sensor formed in the impregnation fixture located in the both ends of a liquid crystal cell, and the fixture for a press.
[Drawing 5] It is the outline sectional view showing an example of the adjustment device of a press pressure to the liquid crystal cell in a vacuum housing.
[Drawing 6] Degassing of the liquid crystal in a liquid crystal degassing vacuum housing and an example of degassing processing are shown.
[Drawing 7] It is the outline sectional view showing an example of the removal means of the liquid crystal adhering to the liquid crystal cell in a surplus liquid crystal removal container.
[Drawing 8] It is the outline sectional view showing detection of the oil level of the liquid crystal in a liquid crystal pan recovery station, and the outline of a supplement of liquid crystal.
[Drawing 9] It is the explanatory view showing the relation of the injected hole of a liquid crystal cell and encapsulant in a closure container.
[Drawing 10] It is the explanatory view showing the condition of carrying out the UV irradiation of the injected hole part of the liquid crystal cell which adhered encapsulant in the closure container under the atmospheric pressure environment permuted with inert gas.
[Drawing 11] The vacuum pressure value in a liquid crystal cell degassing vacuum housing, and H2 O+ The graph the ion current value of a mass spectrum is indicated to be in accordance with time amount is shown.
[Drawing 12] O2 of the air component in a liquid crystal degassing vacuum housing And the fragmentation of H2 O of moisture and a liquid crystal component is detected, and an example of the graph which controls the degree of vacuum is shown.
[Drawing 13] After making the injected hole of a liquid crystal cell immersed in liquid crystal in a liquid crystal impregnation vacuum housing, it is an example of the graph which shows change of **** from a vacua to atmospheric pressure.
[Description of Notations]
A Liquid crystal cell degassing vacuum housing
B Liquid crystal impregnation vacuum housing
C Liquid crystal degassing vacuum housing
D Immersion impregnation station
E Surplus liquid crystal removal container
F Closure container
G Liquid crystal pan recovery station
1 Liquid Crystal Cell
2 Vacuum Mass Vacuum Exclusion System
3 Vacuum Bulb
4 Infrared-Heating Lamp
8 Mass Spectrometer
9 Liquid Crystal Pan
17 Liquid Crystal
21 Impregnation Fixture
23 Pressure Sensor
24 Fixture for Press
29 Minute ******
30 Ultrasonic Generator
31 Rotary-Pump Exhaust Air System
32 Roller of Sponge Quality of the Material
36 Encapsulant

37 UV Light Source Lamp

[Translation done.]

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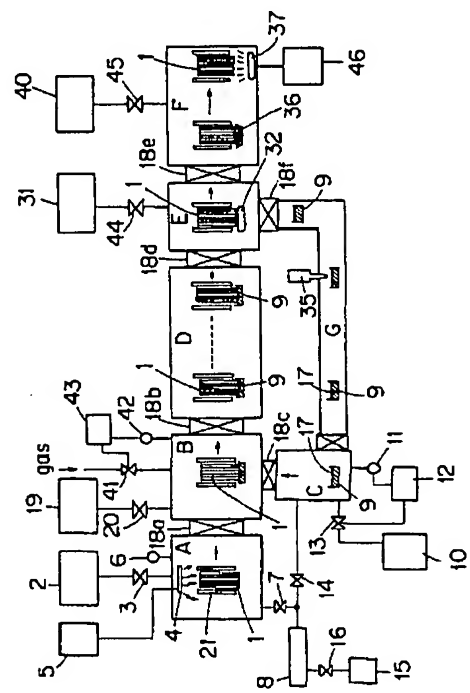
(54)【発明の名称】　液晶表示素子の製造装置及びその方法

(57)【要約】

【目的】液晶セルの脱気，液晶の脱泡から液晶セルの注入孔の封止までの一連の各工程を、真空または不活性ガス置換された大気圧環境下においてインラインで行なうことができる手段を提供することを目的とする。

【構成】液晶セルに液晶を注入する真空容器Bには、液晶セル脱気真空容器A、液晶脱泡真空容器C及び浸漬注入ステーションDとを夫々接続し、該浸漬注入ステーションDには、余剰液晶を除去する真空容器E及び封止する真空容器Fを設け、液晶皿の液晶の量を制御して真空容器Cに送る液晶皿回収ステーションGを備え、大型の液晶セル基板において品質の優れた液晶表示素子が得られる。



【特許請求の範囲】

【請求項１】　液晶セル内外の圧力差と毛細管現象を利用して液晶セル内に液晶を注入して液晶表示素子を形成する液晶表示素子の製造装置において、液晶セルに液晶を注入する液晶注入真空容器を設け、該液晶注入真空容器には、液晶セルを加熱脱気する液晶セル脱気真空容器、液晶を真空脱泡する液晶脱泡真空容器、液晶セルを液晶に浸漬させたまま放置する浸漬注入ステーションとを夫々接続し、且つ、該浸漬注入ステーションには、不活性ガス置換した大気圧下において、浸漬注入ステーションから受け渡された液晶セルと液晶皿とを分離し、余剰液晶を除去する余剰液晶除去容器と、液晶セルの液晶注入口を封止する封止容器とを設けると共に、前記分離された液晶皿の液晶の量を所定にして前記液晶脱泡真空容器に送る液晶皿回収ステーションを備え、液晶セルの加熱脱気、液晶の脱泡、液晶の注入、余剰液晶の除去及び注入孔の封止の各工程を真空環境下と不活性ガス置換した大気圧下においてインラインで行なうことを特徴とする液晶表示素子の製造装置。

【請求項２】　液晶セルの脱気工程として、液晶セルを10^{-4}Torr～10^{-5}Torrの真空下に配置し、赤外線ランプ等の非接触式加熱手段を用いて加熱脱気させ、高真空大容量排気ポンプにより短時間のうちに水分等の残留分子を離脱させると共に、脱気中の放出ガス成分を検出することにより、液晶セルの脱気処理工程を終了させ、液晶セルを真空注入工程に送ることを特徴とする液晶表示素子の製造方法。

【請求項３】　液晶皿に充填された液晶の脱泡工程として、真空排気の初期における真空排気速度を大きくし、液晶内に溶存している空気を主成分とする気体泡を10^{-2}Torr～10^{-3}Torrの真空下において速かに脱泡すると共に、揮発する液晶成分を質量分析計によって監視し、この監視に基づいて液晶の脱泡処理工程を終了させ、液晶の揮発分を極力抑制することを特徴とする液晶表示素子の製造方法。

【請求項４】　液晶皿に充填された液晶の脱泡工程として、真空環境下において液晶皿内の液晶に超音波による振動エネルギーを加えると共に、表面が平滑でかつ液晶と反応しない微小な鋼体球を液晶内に混入し、液晶内に含まれる気体泡の脱泡を促進し、短時間に脱泡を行なうことを特徴とする液晶表示素子の製造方法。

【請求項５】　液晶セル内に液晶を真空注入する工程において、１枚もしくは複数枚の液晶セルを一定かつ均一な保持力で保持できる液晶セル収納治具に支持し、液晶セルを支持する液晶セル収納治具は、少なくとも３つの押圧部と、それに対応する位置に圧力検出器を有し、圧力検出器の個々の圧力データ値を押圧部にフィードバックし、液晶セルの面圧力の均一性とセルキャップを一定にすることを特徴とする液晶表示素子の製造方法。

【請求項６】　液晶セル内に液晶を真空注入する工程において、液晶注入真空容器の圧力を10^{-3}Torr～10^{-4}Torrに保持した状態で、該液晶注入真空容器内に液晶セルを配置し、液晶脱泡真空容器から送られてきた液晶皿に充填された液晶内に該液晶セルの注入孔を浸漬した後、液晶注入真空容器内の圧力を大気圧もしくは大気圧以上に復圧する際に、真空状態からの復圧状態への圧力変化を絶対圧真空計でモニターし、最初は液晶セル内に表面張力によってゆっくり液晶を液晶セル内に侵入させ、少しずつ不活性ガス等のガスを導入して液晶注入真空容器内の真空度を下げながら徐々に復圧し、次第に復圧の速度を大きくし、時間と復圧速度を、液晶セルの基板の性質、液晶セルのサイズ等に応じてプログラム制御することを特徴とする液晶表示素子の製造方法。

【請求項７】　液晶セルに液晶を注入した後、浸漬注入ステーションから回収された液晶皿を移送される液晶皿回収ステーションにおいて、透明部材で作られた液晶皿の液晶液面の管理を透過型光電スイッチ等の液面検出手段を用いて行い、前記液面検出手段の信号により適正なレベルまで液晶の補給を充填手段により自動的に行ない、所定の液晶を収容した液晶皿を液晶脱泡真空容器に送ることを特徴とする液晶表示素子の製造方法。

【請求項８】　液晶注入を完了した液晶セルの余剰液晶除去する工程として、不活性ガス置換した大気圧下において液晶セル注入孔付近の余剰な液晶を柔かい清掃具で払拭し、余剰液晶除去する工程に接続された液晶セルの注入孔を封止剤により封止する工程として、不活性ガス置換した大気圧下において液晶セルの注入孔を封止剤により封止することを特徴とする液晶表示素子の製造方法。

【請求項９】　液晶セルの注入孔を封止剤により封止する工程として、不活性ガス置換した大気圧下において液晶セルの注入孔部分に紫外線硬化型樹脂の封止剤を塗布した後、紫外線を照射し、封止剤を硬化させることを特徴とする請求項８記載の液晶表示素子の製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、液晶表示素子に液晶を注入する際の製造装置及びその方法に関するものである。

【０００２】

【従来の技術】液晶表示素子の製造するに際して、液晶セルに液晶を注入する工程は重要な工程であって、表示品質や歩留りに直接影響を与えている。液晶セルに液晶を注入する方法としては真空注入方法が最も一般的である。

【０００３】従来の真空注入方法は、真空容器内に液晶セル及び液晶を設置し、真空容器内の圧力を10^{-3}Torr程度の真空度に保持した後、液晶セルの注入孔を液晶に浸漬させ、真空容器内を大気圧に復圧することにより、液晶セル内外の差圧力及び液晶セル内の微小な間隙（ギ

ャップ）における毛細管現象によって液晶の注入を行なうものである。

【０００４】このような従来方式では、液晶セルの大型化により、また液晶セル基板としてガラス基板以外の、例えば可撓性フィルム基板を用いることにより、液晶セルへの液晶注入に際しては、液晶セル内部に気泡の残留が生じたり、注入に要する時間が長時間となったり、液晶の注入状態により表示品質が定常的に確保できないという問題点があった。

【０００５】液晶セル内を充分に負圧（真空状態）にして液晶セル内部の水分や不純物を除去することは、注入後の気泡の残留や発生（電界印加による動作気泡）を抑制するために必要であり、これを液晶の注入前に事前に行っている。従来では、真空注入容器において行わず、別個の脱気工程として、クリーンオーブンまたは真空脱気法により別容器で行なっている。このような従来の方法では、充分に脱気、脱ガスした液晶セルを再び大気中に曝すことになり、水分等の再付着やセル内部の復圧により、次の真空注入工程の効率や品質確保に不利となる欠点を有している。

【０００６】同様に、液晶セルの注入孔を液晶に浸漬させ、残留気泡を伴うことなく注入を行なうため、空気中においてそのまま放置するが、特に液晶セルが可撓性フィルム基板の場合には水分や空気成分の付着や透過が問題となる。さらに注入が完了したときに注入孔を封止剤によって封止するが、注入孔付近の余剰液晶のふき取りや封止剤塗布、紫外線硬化型樹脂の硬化を空気中で行なうことは、空気成分やその他の不純物の侵入や液晶セル内の気泡残留の原因となっている。

【０００７】また、液晶セルの液晶注入前の脱気工程において、従来10^{-3}Torr～10^{-4}Torrで行ってきた真空排気は、水分等不純物の脱気には不十分であり、大量の大型セル基板やフィルム基板を用いる場合に、脱気時間を大幅に短縮するのは困難であった。更に、セルの脱気状態（脱気効果）を知る手段がないことから、充分に脱気が終了しているにもかかわらず、無益に脱気工程を続けているという欠点を有している。

【０００８】液晶内に存在する気体の脱気（脱泡）は、従来、10^{-2}Torr～10^{-4}Torr程度の真空度において行なっているが、液晶内に溶存する気体が脱離し終った状態で長時間真空排気を続けると液晶の成分が揮発して真空容器内を汚染したり、液晶の余計な消耗の原因となっている。したがって脱泡のための真空排気は引き始めは液晶から発生する泡が破裂して液晶が飛散しないようにゆっくり真空排気（スロー排気）して次第に排気速度を大きくして速かに脱泡を行ない、さらに液晶成分が組成変化しないように揮発分を抑えることが必要である。

【０００９】また、液晶の従来の脱泡工程では、溶存気体の脱離を促進するために、真空排気しながらマグネットスターラーを用いていたが、これはむしろ小さい気泡

を拡散し脱泡時間が長くなる傾向があった。

【００１０】大型の液晶セル基板、特に可撓性フィルム基板で作られた液晶セル内に液晶を注入する場合、真空容器内に液晶セルを置くと、液晶セル内外圧の差によって液晶セルが膨張、収縮したりして注入された液晶のムラが発生している。注入のムラは表示品質に影響するのでセルを一定間隔で保持し、液晶セル内のギャップが大きく変化しないように注入する必要がある。

【００１１】液晶セルに液晶を注入する際に、真空容器内に置かれて充分に減圧（真空）状態にされた液晶セル内部には注入当初は液晶セルギャップと液晶の表面張力によって液晶が入り込む。このとき復圧（真空容器内をリークする）を急激に行なうと、液晶セル内の間隙を一定に保つために散布しているギャップ剤が動いたり、液晶の入り方が均一にならないなどの問題があった。特に可撓性フィルム基板や大型基板のセルでは復圧する場合の速度（リーク速度）や注入を完了するまでの時間の管理が困難で、気泡が残留しやすいなどの問題点があった。

【００１２】また、従来、液晶セル内に液晶を注入した後、余剰液晶を拭き取り、注入孔を封止剤を用いて封止していたが、これらの工程はいづれも空気中で行なっており、この場合、余剰液晶の拭き取り時に注入孔から空気が入り込んだり、封止剤塗布時に異物や空気が侵入して封止不良の原因になることが多く、安定した品質を確保することができなかった。更に、紫外線硬化型樹脂は水分や空気中の酸素に対して影響を受け、特に水分については品質の経年劣化の原因となる。

【００１３】

【発明が解決しようとする課題】本発明は、上述の不具合点を改善するため、液晶セルの脱気，液晶の脱泡の工程から液晶セルの注入孔の封止の工程までの一連の工程を、真空環境下（一部は不活性ガス置換）においてインラインで行なうことができる方法及び装置を提供することを目的とし、液晶セルに液晶を注入するに際しての各工程における優れたやり方を提供することを目的とするものである。

【００１４】そして、本発明は、真空の環境下で、液晶セルの脱気，液晶の脱泡，液晶の注入を行った後、余剰液晶の除去，注入孔の封止の各工程においても、空気や水分に触れることのない環境下で処理をすることができ、高品質の液晶表示素子を製造しうる手段を提供することを目的とする。

【００１５】本発明の各工程では、液晶表示素子を大量生産すると共に最小のコストで効率良い液晶セルの脱気工程を提供し、液晶の組成変化を防ぎ、液晶内の気泡を拡散させないで振動エネルギーを加えることにより確実に速く行いうる脱泡工程を提供し、また、液晶注入の際、液晶セルの基板間のギャップを一定に維持することができる液晶注入工程を提供し、更に、液晶セルに液晶

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を注入する際に使用される液晶皿の液面を一定に維持する液晶皿注入ステーションを提供し、且つ、水分、酸素を排除した環境下で行いうる余剰液晶除去及び封止の各工程を提供することを目的とする。

【００１６】

【課題を解決するための手段】本発明は、前記目的を達成するために、液晶セル内外の圧力差と毛細管現象を利用して液晶セル内に液晶を注入して液晶表示素子を形成する液晶表示素子の製造装置において、液晶セルに液晶を注入する液晶注入真空容器を設け、該液晶注入真空容器には、液晶セルを加熱脱気する液晶セル脱気真空容器、液晶を真空脱泡する液晶脱泡真空容器、液晶セルを液晶に浸漬させたまま放置する浸漬注入ステーションとを夫々接続し、且つ、該浸漬注入ステーションには、不活性ガス置換された大気圧下において、浸漬注入ステーションから受け渡された液晶セルと液晶皿とを分離し、余剰液晶を除去する余剰液晶除去容器と、液晶セルの液晶注入口を封止する封止容器とを設けると共に、前記分離された液晶皿の液晶の量を所定にして前記液晶脱泡真空容器に送る液晶皿回収ステーションを備え、液晶セルの加熱脱気、液晶の脱泡、液晶の注入、余剰液晶の除去、注入孔の封止の各工程を真空環境下と不活性ガス置換した大気圧下においてインラインで行なうことを特徴とするものである。

【００１７】また、本発明は、液晶の脱気工程として、液晶セルを10^{-4}Torr～10^{-5}Torrの真空下に配置し、赤外線ランプ等の非接触式加熱手段を用いて加熱脱気させ、高真空大容量排気ポンプにより短時間のうちに水分等の残留分子を離脱させると共に、脱気中の放出ガス成分を検出することにより、液晶セルの脱気処理工程を終了させ、液晶セルを真空注入工程に送ることを特徴とするものである。

【００１８】本発明は、液晶皿に充填された液晶の脱泡工程として、真空排気の初期における真空排気速度を大きくし、液晶内に溶存している空気を主成分とする気体泡を10^{-2}Torr～10^{-3}Torrの真空下において速かに脱泡すると共に、揮発する液晶成分を質量分析計によって監視し、この監視に基づいて液晶の脱泡処理工程を終了させ、液晶の揮発分を極力抑制することを特徴とし、また、真空環境下において液晶皿内の液晶に超音波による振動エネルギーを加えると共に、表面が平滑でかつ液晶と反応しない微小な鋼体球を液晶内に混入し、液晶内に含まれる気体泡の脱泡を促進し、短時間に脱泡を行なうことを特徴とするものである。

【００１９】本発明は、液晶セル内に液晶を真空注入する工程において、１枚もしくは複数枚の液晶セルを一定かつ均一な保持力で保持できる液晶セル収納治具に支持し、液晶セルを支持する液晶セル収納治具は、少なくとも３つの押圧部と、それに対応する位置に圧力検出器を有し、圧力検出器の個々の圧力データ値を押圧部にフィ

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ードバックし、液晶セルの面圧力の均一性とセルキャップを一定にすることを特徴とするものである。

【００２０】本発明は、液晶セル内に液晶を真空注入する工程において、液晶注入真空容器の圧力を10^{-3}Torr～10^{-4}Torrに保持した状態で、該液晶注入真空容器内に液晶セルを配置し、液晶脱泡真空容器から送られてきた液晶皿に充填された液晶内に該液晶セルの注入孔を浸漬した後、液晶注入真空容器内の圧力を大気圧もしくは大気圧以上に復圧する際に、真空状態からの復圧状態への圧力変化を絶対圧真空計でモニターし、最初は液晶セル内に表面張力によってゆっくり液晶を液晶セル内に侵入させ、少しずつ不活性ガス等のガスを導入して液晶注入真空容器内の真空度を下げながら徐々に復圧し、次第に復圧の速度を大きくし、時間と復圧速度を、液晶セルの基板の性質、液晶セルのサイズ等に応じてプログラム制御することを特徴とするものである。

【００２１】更に、本発明は、液晶セルに液晶を注入した後、浸漬注入ステーションから回収された液晶皿を移送される液晶皿回収ステーションにおいて、透明部材で作られた液晶皿の液晶液面の管理を透過型光電スイッチ等の液面検出手段を用いて行い、前記液面検出手段の信号により適正なレベルまで液晶の補給を充填手段により自動的に行ない、所定の液晶を収容した液晶皿を液晶脱泡真空容器に送ることを特徴とするものである。

【００２２】本発明は、液晶注入を完了した液晶セルの余剰液晶除去する工程として、不活性ガス置換された大気圧下において液晶セル注入孔付近の余剰な液晶を柔かい清掃具で払拭し、余剰液晶除去する工程に接続された液晶セルの注入孔を封止剤により封止する工程として、不活性ガス置換された大気圧下において液晶セルの注入孔を封止剤により封止することを特徴とするものである。

【００２３】

【作用】本発明の構成により、液晶セルの脱気及び液晶の脱泡から液晶セルの注入孔の封止迄の各工程を、真空下または不活性ガス置換の環境下においてインラインで行うことにより、余剰液晶の除去工程や注入孔の封止工程において空気や水分に触れることがなく、大型の液晶セル基板や可撓性フイルム基板において品質の優れた液晶表示素子を得ることができる。

【００２４】

【実施例】以下、本発明の実施例を図面に基づいて説明する。図１には、本発明の装置全体の概要を示している。本発明の液晶注入工程、すなわち、液晶セルの脱気，脱ガス、液晶の脱泡、液晶セルへ液晶の注入、液晶セルの注入孔の封止等の各工程をインラインで行なう装置の構成図である。

【００２５】液晶セルに液晶を注入する真空容器Ｂ（以下、液晶注入真空容器という）には、液晶セルの脱気，脱ガスを行う真容器空Ａ（以下、液晶セル脱気真空容器

という）と、液晶皿に所定量の液晶を入れた液晶の脱泡を行う真空容器Ｃ（以下、液晶脱泡真空容器という）とが接続されると共に、液晶セル内に液晶を完全に注入する浸漬注入ステーションＤが接続され、且つ浸漬注入ステーションＤには、液晶皿から液晶セルを分離し、液晶セルに付着した液晶を取り除く容器Ｅ（以下、余剰液晶除去容器という）と、該余剰液晶除去容器Ｅには、液晶セルの注入孔を封止する容器Ｆ（以下、封止容器という）と、液晶皿が送り込まれる液晶皿回収ステーションＧとが接続されている。そして、液晶皿回収ステーションＧの他端は、前記液晶脱泡真空容器Ｃに接続されている。

【００２６】先ず、液晶セル脱気真空容器Ａの構成・作動について説明をする。液晶セル脱気真空容器Ａ内に配置された液晶セル１は、クライオポンプ（またはターボ分子ポンプ）を主ポンプとする高真空大容量真空排除系２により真空度（圧力）を１０^{-5}Torr程度とし、液晶セル１の脱気、脱ガスを行なう。真空度は、水分の放出量が多い場合でも１０^{-4}Torr程度である。３は真空バルブである。

【００２７】そして、そのような真空下において、液晶セル脱気真空容器Ａ内に配置された赤外線加熱ランプ４により液晶セルの素材が物理、化学的に変質しない温度範囲で均一に加熱し、液晶セル１内外の水分等の不純物を取り除くと共に液晶セル内部を真空にする。５は前記赤外線加熱ランプ４を作動させる電源である。液晶セル１は後述する注入治具にセットされている。液晶セルの加熱温度は、プラスチックの場合、前記温度で良いが、ガラスの場合はプラスチックよりも高い温度、例えば１００℃付近まで加熱してもかまわない。

【００２８】この液晶セル脱気真空容器Ａの真空度は電離真空計６で測定されると共に、バルブ７の開放により、液晶セル脱気真空容器Ａと質量分析計８を接続し、質量分析計８で液晶セル脱気真空容器Ａ内のガス分析を行う。図１１には、電離真空計６による真空度と、質量分析計８によるH_2O^+の質量スペクトルのイオン電流値とをモニターし、その時間変化を追ったグラフであり、このグラフにより、一定時間のうちに真空度、及びH_2O分圧値が共にあらかじめ設定したレベル以下になったことを検知し、液晶セル脱気真空容器Ａでの処理を終了する。液晶セル脱気真空容器Ａに付属する粗引（真空）排気系及びリーク弁について図１では省略してある。

【００２９】次に、液晶脱泡真空容器Ｃの構成・作動について説明する。液晶セル脱気真空容器Ａにおける処理作業と並行して、液晶皿回収ステーションＧから回収され、液晶液面を適正レベルに保つた液晶皿９は液晶脱泡真空容器Ｃに送られてくる。液晶脱泡真空容器Ｃは、メカニカルブースターポンプ排気系１０で１０^{-1}～１０^{-4}Torrの範囲で真空排気される。

【００３０】このとき、液晶脱泡真空容器Ｃ内のガス分析が質量分析計８により行われ、空気成分のO_2及び水分のH_2O及び液晶成分のフラグメントを検出し、その時間変化をモニターする。一例として図１２に示されるグラフのように、O_2分圧及びH_2O分圧が一定の設定のレベル以下になり、液晶成分のフラグメントイオンが大きく増加し始めたことを検知することにより、真空度を制御し、液晶成分が揮発することを阻止する。真空度の制御は隔膜真空計１１を用い、圧力制御器１２によって可変コンダクタンスバルブ１３を制御することによって行なわれる。

【００３１】液晶脱泡真空容器Ｃ内にガス分析において、真空度の状態で質量分析計８を直接使えない領域なので、バルブ１４を開いてガスを導入しながらターボ分子ポンプ排気系１５を用いて差動排気を行なって分析する。バルブ１６は差動排気法を使わない場合は閉じておく。なお、液晶セル脱気真空容器Ａと液晶脱泡真空容器Ｃの処理中に、ガス分析を並行して行なうときはバルブ７とバルブ１６を切り換えて分析を行なうようにする。

【００３２】以上のように、本発明の液晶脱泡工程を真空中で行なうことにより、コンダクタンス可変バルブを用いて真空排気のプロセスを制御する際に、液晶の飛散、液晶の揮発を伴うことなく液晶に溶存する気体を除去することができ、迅速に脱泡工程を行なうことができる。また、質量分析計によるガス分析により液晶の揮発成分のフラグメントイオンを検出することにより液晶が揮発しないような真空排気のプロセスに制御でき、液晶の成分変化を未然に防ぎ品質の安定化がはかられる。

【００３３】液晶脱泡真空容器Ｃにおける液晶１７の脱泡，脱気処理の概要を、図６で説明する。液晶皿９に収容された液晶１７には、微小な鋼体球２９を混入する。そして、液晶皿９の下方に超音波発生器３０を配置し、微小な鋼体球２９を混入した液晶１７に超音波を加える。このとき、真空容器Ｃ内に加熱機構を設け、加熱しながら脱泡を行なうことも可能であり、特に強誘電液晶の場合は好都合である。前記微小な鋼体球２９としては、表面が非常に平滑でかつ液晶と反応しない直径０．２～０．８mmの鋼体球であり、アルミニウム、テフロン等を使用することができ、その比重は液晶よりやや重いものであることが好ましい。よって、液晶脱泡時において超音波による振動エネルギーとそれによって引き起こされる適度な温度上昇により、液晶に溶存する気体を迅速に残留気泡なく除去することができる。

【００３４】次いで、液晶注入真空容器Ｂの構成・作動について説明する。液晶セル脱気真空容器Ａで処理された液晶セル１（注入治具にセットされたもの）及び液晶脱泡真空容器Ｃで処理された液晶１７を収容した液晶皿９は、予め１０^{-3}～１０^{-4}Torrに真空排気された液晶注入真空容器Ｂに、夫々ゲートバルブ１８ａ，１８ｃを介して送り込まれ、図１の状態に設置される。液晶注入真

空容器Ｂはターボ分子ポンプ排気系１９で真空排気される。真空容器Ｂの粗引排気系及びリーク系は図１では省略している。２０は真空バルブである。

【００３５】液晶セル１は、図２（ａ）に示されるように注入治具２１ａ～２１ｃに支持される。図２において、液晶セル１は、液晶セル間を一定に保ち、押圧時の面圧力を均一にするためのバッファシート２２を介して支持され、その両側には、注入治具２１ａ～２１ｃが配置されている。そして、液晶セル１は、図２（ｂ）に示されるように、その注入孔部分を液晶皿９内の液晶１７の内部に浸漬するように液晶皿９の位置が調整される。

【００３６】液晶セル１は、図３に示されるような正面からの断面形状をしており、１ａは液晶が注入されるエリア、１ｂはシール部、１ｃは注入孔を示している。可撓性フィルム基板で構成された液晶セル１の両端に位置する注入治具２１ａ～２１ｃの一方には、図４に示すように、少なくとも３つの圧力検出器２３が配置され、該圧力検出器２３によって液晶セル１面内の全圧を一定になるように保持すると共に、且つ面内の押圧時の圧力分布を均一にするよう制御する。２４は注入治具２１ａ～２１ｃの他方の面に設けられたプレス用の治具の一部である。液晶セルのプレスは可撓性フィルム基板の場合に有効であるが、ガラス基板の場合にも有効である。

【００３７】液晶セル１のプレス方法の一例を図５に示している。この図５において、真空下においてもプレス圧力が調整できる構造となっており、２５は真空用回転導入器、２６はカップリング、２７はネジ部であり、真空用回転導入器の回転を、押圧のための直線運動に変える。よって、注入治具２１の圧力検出器２３からの信号が、真空容器の壁部２８の外側に配置された真空用回転導入器２５に与えられると、所定のネジ部２７が前後に移動し、プレス用治具２４は液晶セルの全面にわたり圧力が一定になるように作用する。

【００３８】特に、大型セル基板や可撓性フィルム基板によるセルサイズの大型化により、注入時に液晶の濃淡部の発生やセルギャップの不均一が生じ易い欠点は、前述したように、注入処理時の押圧手段で一定の面圧力の均一性を確保することにより、液晶表示素子の表示品質の安定化を図ることができる。本発明では、注入前、真空下において、セル内部を減圧状態にしたまま液晶セルの面内に対する押圧する力の均一性を確保できるので、正確な注入条件（プレス注入）を設定することが可能である。

【００３９】液晶注入真空容器Ｂにおいて、図２（ｂ）に示されるように液晶セル１の注入孔１ｃを液晶１７に浸漬させた後、図１３に示されるようにシーケンシャルに真空状態から大気圧（または大気圧より若干加圧した程度の圧力）迄復圧する。図１３に示されるように、10^{-4}Torrに真空排気された液晶注入真空容器Ｂの圧力は、先ず、時間 t_1 の間、ゆっくりガスを導入して復圧し、時間 t_2 の間、ガスのリークレートを大きくし、時間 t_3 の間で再び徐々にリークして、更に時間 t_4 の間で比較的速く大気圧まで復圧する。そして、必要に応じて時間 t_5 の間で大気圧より更に圧力を高める。このシーケンスは基本的なパターンであり、液晶の種類、液晶セル基板の大きさによって変えることができる。図１において、４１は可変流量リークバルブであり、該可変流量リークバルブ４１は真空計４２により圧力制御器４３を制御し、ガスを前述のように導入することができる。

【００４０】よって、本発明では、液晶セルのサイズに応じて復圧状態をコントロールすることにより、ギャップ剤の移動を引き起こすことなく、液晶を液晶セル内に均一に全ての部分に注入することができ、注入時の残留気泡を無くすことができる。そして、真空から大気圧もしくは大気圧より高い圧力に復圧する工程を時間管理する以外に、液晶セルのサイズに応じて圧力（真空度も含む）と時間のシーケンシャルなプログラムにより変化させることによって、液晶表示素子の量産化を図ることができる。

【００４１】液晶注入真空容器Ｂにおいて、液晶セル１に液晶１７を真空注入法によって注入した後、液晶セル１内に完全に液晶１７を注入し、残留気泡を残さないため、液晶１７に浸漬した状態にある液晶セル１は、真空と大気圧を仕切るゲートバルブ１８ｂを介して浸漬注入ステーションＤに送られる。浸漬注入ステーションＤでは、窒素ガスフローまたは窒素ガス置換のクリーン環境下で少なくとも３時間に亘り、液晶セル１の注入孔１ｃを液晶１７に浸漬させたまま送られる。

【００４２】浸漬注入ステーションＤにおいて、液晶セル１に液晶を完全に注入し終えた後に、液晶セル１と液晶皿９は、ゲートバルブ１８ｄを介して、余剰液晶除去容器Ｅに送られる。そして、この余剰液晶除去容器Ｅでは、ロータリーポンプ排気系３１でゆっくり排気後、不活性ガス置換した環境下において、液晶皿９を液晶セル１から離し、液晶セル１に付着した余剰液晶１７ａは、図７に示されるように、スポンジ材質のローラー３２を回転して柔かく拭き取ることができる。４４は真空バルブである。余剰液晶１７ａを拭き取られた液晶セル１は、ゲートバルブ１８ｅを介して封止容器Ｆに送られる。その後、液晶皿９はゲートバルブ１８ｆを介して液晶皿回収ステーションＧに送られる。

【００４３】液晶皿回収ステーションＧにおいて、図８に示されるように、透過可能の液晶皿９の両側に配置された透過型光電スイッチ３３ａ，３３ｂと３４ａ，３４ｂによって、液晶皿９の液晶１７内の液面の上，下面レベルが設定され、設定の下面レベルより液晶液面の位置が下にある場合、液晶１７はディスペンサ等の補充手段３５を用いて供給され、その液面が設定の上面レベルを越えない範囲で補充される。

【００４４】本発明の液晶皿回収ステーションでは、液

晶皿内の液晶の量を自動的に非接触手段により検出し、液晶の補給を自動的に行なうことにより、注入において必要な液面管理を無人で行なうことができ、液晶の注入工程の自動化に大きく寄与できる。そして、補給される液晶には、通常、気体が溶存しており、液晶液面の管理と補給は真空容器内で行う必要性はなく、クリーントンネル等の清浄環境下において実施し、このような液晶皿回収ステーションから液晶脱泡用の真空容器に送ることになる。

【００４５】封止容器Ｆ内において、液晶セル１の注入孔１ｃ部分は、図９に示されるように封止剤３６に浸漬させた後、図１０に示されるように前記注入孔１ｃ部分に付着した封止剤３６は、不活性ガス置換大気圧中におけるＵＶ光源ランプ３７の照射光３８によって硬化され、注入孔１ｃは封止される。３９は封止剤以外の部分にＵＶ照射光が当たらないようにするための遮蔽板で、液晶や基板の変質を防ぐものである。なお、封止容器Ｆは、ロータリーポンプ排気系４０によって真空排気するが、リーク系は図示していない。４５は真空バルブ、４６はＵＶ光源ランプの電源である。

【００４６】以上のように、本発明では、液晶セル注入孔１ｃ付近に付着した余剰液晶１７ａをふき取るため、ゆっくり真空ポンプで排気した後、図示しないガス導入系から不活性ガス（N_2 ガスなど）を導入して大気圧とし、注入孔端面付近にスポンジローラ３２を当接させて、注入孔端面に付着した余剰液晶１７ａを吸い取り、その後、同一の不活性ガスの大気圧環境下において、注入孔１ｃを封止剤中に浸漬するか、ディスペンサ等の塗布手段を用いて塗布することにより、液晶セル内への空気の侵入を防いだ状態で完全な封止を行なうことができる。液晶セル内への空気の侵入の他に、表示素子としての経時的な特性変化の大きな原因となる水分や不純物の混入をも真空下においては防ぐことができる。

【００４７】

【発明の効果】本発明の構成により、液晶セルの脱気、脱ガス、液晶の脱泡、真空注入、液晶浸漬、封止剤塗布、封止剤の硬化等の各工程を真空容器を連結して、真空下または不活性ガス置換の環境下でインラインで処理するため、液晶セルの脱気から注入孔の封止までの液晶セルの各工程を連続的に移動して処理することができ、全工程において空気や水分に触れることなく、大型セル基板や可撓性フィルム基板に対して残留気泡や液晶の濃淡部による色調の不均一性、水分や不純物のセル内への混入、封止部の不良などの不具合のない、品質の安定した液晶表示素子を得る効果を有する。

【００４８】また、本発明の構成により、高真空中において、非接触式加熱手段により液晶セルを均一に加熱して脱気、脱ガスを行なうことにより、セル内部を水分等の不純物の少ない減圧（真空）状態にして液晶を注入することができ、安定した品質の表示素子を確保でき、また脱気、脱ガス状態を質量分析計によってガス分析してその終了を知ることができ、効率の良い脱気、脱ガス処理を行ない生産性の向上を図ることができる効果を有する。

【００４９】更に、本発明では、液晶の脱泡を真空中で行なうことにより、液晶の飛散、液晶の揮発を伴うことなく、液晶に溶存する気体を除去することができ、迅速に脱泡を行なうことができ、液晶の成分変化を未然に防ぎ、液晶表示素子の品質の安定化がはかられると共に、液晶脱泡時において超音波による振動エネルギーとそれによって引き起こされる適度な温度上昇により液晶に溶存する気体を迅速に残留気泡なく除去することができる効果を有する。

【００５０】本発明では、液晶注入工程として、大型のセル基板に対しても、注入処理時に押圧手段で一定の面圧力の均一性を確保することができ、表示品質の安定化ができ、液晶セルのサイズに応じて復圧状態をコントロールすることによって、ギャップ剤の移動を引き起こすことなく、均一に全ての部分に液晶を注入することができ、注入時の残留気泡を無くすことができる効果を有する。

【００５１】本発明の液晶皿回収ステーションでは、液晶の減少を自動的に非接触手段により検出し液晶の補給を自動的に行なうことにより、注入において必要な液面管理を無人で行なうことができ注入工程の自動化に大きく寄与できる効果を有する。そして、余剰液晶除去工程及び封止工程を不活性ガスで置換された大気圧下において行うことにより、液晶セル内への空気の侵入を防ぎ、表示素子としての経時的な特性変化に影響を与える水分や不純物の混入を防ぐことができる効果を有する。

【図面の簡単な説明】

【図１】本発明の液晶表示素子の製造装置全体の概要を示す構成図である。

【図２】（ａ）は液晶セルと注入治具との関連を示し、（ｂ）は液晶セルと液晶皿との関連を示す概略断面図である。

【図３】液晶セルの概略断面図である。

【図４】液晶セルの両端に位置する注入治具に設けられた圧力検出器とプレス用の治具との関連を示す概略断面図である。

【図５】真空容器内の液晶セルに対するプレス圧力の調整手段の一例を示す概略断面図である。

【図６】液晶脱泡真空容器における液晶の脱泡，脱気処理の一例を示す。

【図７】余剰液晶除去容器における液晶セルに付着した液晶の除去手段の一例を示す概略断面図である。

【図８】液晶皿回収ステーションにおける液晶の液面の検知、液晶の補充の概要を示す概略断面図である。

【図９】封止容器内における液晶セルの注入孔と封止剤との関連を示す説明図である。

【図１０】封止容器内において封止剤を付着した液晶セルの注入孔部分を不活性ガスで置換した大気圧環境下でＵＶ照射している状態を示す説明図である。

【図１１】液晶セル脱気真空容器内における真空圧力値と、H_2O^+ の質量スペクトルのイオン電流値とが時間経過により示されるグラフを示す。

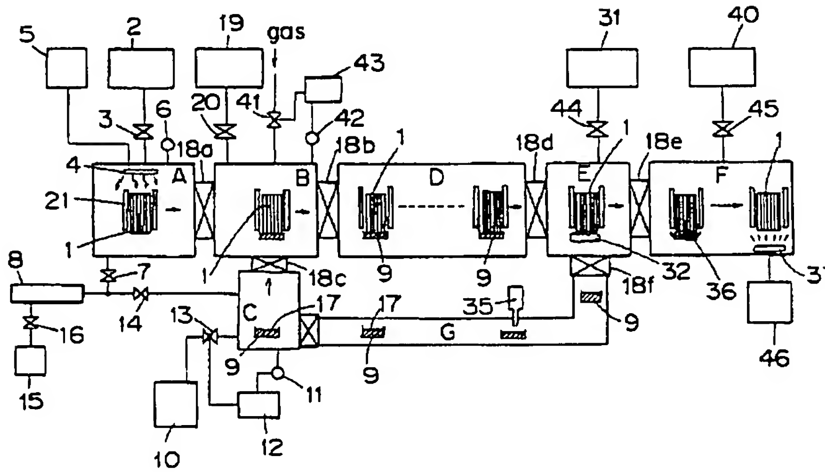
【図１２】液晶脱泡真空容器内の空気成分のO_2 及び水分のH_2O及び液晶成分のフラグメントを検出し、その真空度を制御するグラフの一例を示す。

【図１３】液晶注入真空容器において液晶セルの注入孔を液晶に浸漬させた後、真空状態から大気圧迄の復圧の変化を示すグラフの一例である。

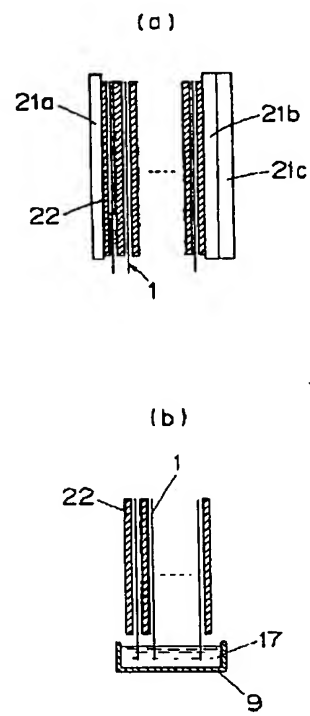
【符号の説明】

A	液晶セル脱気真空容器
B	液晶注入真空容器
C	液晶脱泡真空容器
D	浸漬注入ステーション
E	余剰液晶除去容器
F	封止容器
G	液晶皿回収ステーション
1	液晶セル
2	真空大容量真空排除系
3	真空バルブ
4	赤外線加熱ランプ
8	質量分析計
9	液晶皿
1 7	液晶
2 1	注入治具
2 3	圧力検出器
2 4	プレス用治具
2 9	微小な鋼体球
3 0	超音波発生器
3 1	ロータリーポンプ排気系
3 2	スポンジ材質のローラー
3 6	封止剤
3 7	ＵＶ光源ランプ

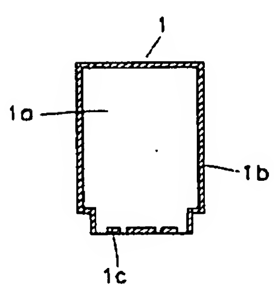
【図１】



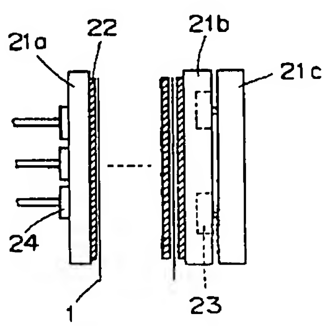
【図２】



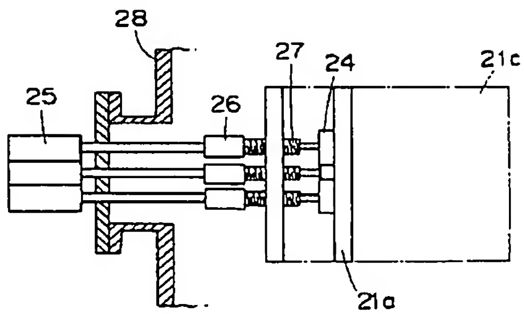
【図３】



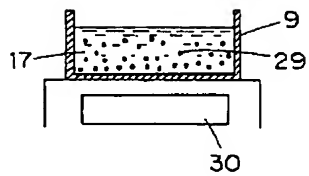
【図４】



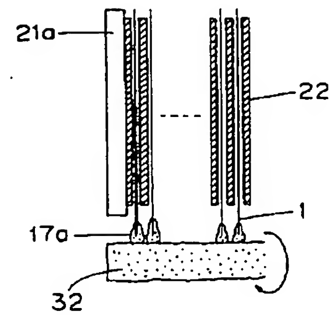
【図5】



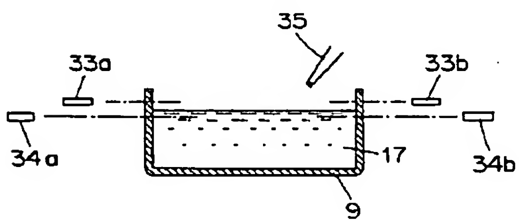
【図6】



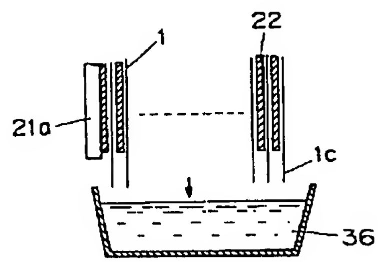
【図7】



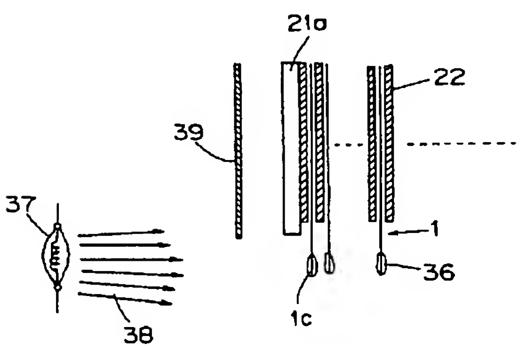
【図8】



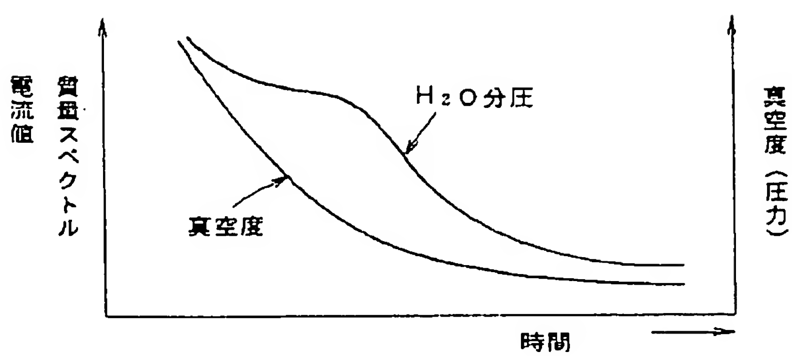
【図9】



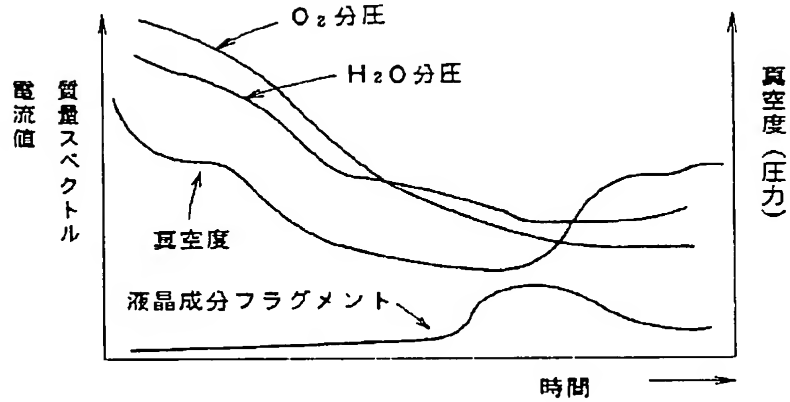
【図10】



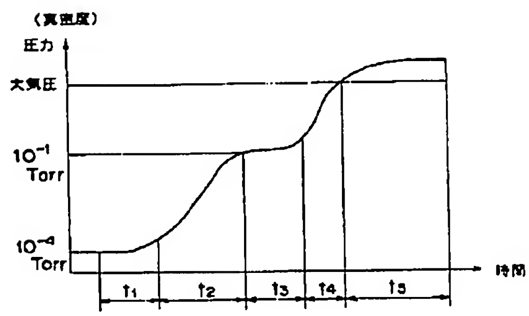
【図11】



【図１２】


O₂分圧
H₂O分圧
電流値
質量スペクトル
真空度（圧力）
真空度
液晶成分フラグメント
時間

【図１３】


（真空度）
圧力
大気圧
10⁻¹ Torr
10⁻⁴ Torr
時間
t1
t2
t3
t4
t5